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Research Article

The Role of Lean Production Practices and Industry 4.0 Implementation in Indonesian SMEs

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Abstract

This study to examined the practice of industry 4.0 and lean production implementation in Indonesia SMEs, therefore the result can be used to identify the aspect of industry 4.0 which is affecting lean production, identify their roles in the business performance and provide direction to the business practices in implementing industry 4.0 for Indonesia SMEs.

The study utilized the Statistical Package Pocket Social Sciences (SPSS) version 22.0 software. The respondents are owner, director, manager and, acting manager from 25 SMEs and, the statements of questioner the role of lean production practices and, industry 4.0 implementation in Indonesia SMEs, the questions of interview of lean production practices, however, it used only four from nine indicators of industry 4.0.

The growth of SMEs in Indonesia increased post of 1997-1998 monetary crisis also during the covid pandemic, the SMEs continues to increase of prior studies analyzed about the importance of lean manufacturing for SMEs and the challenge of Industry 4.0 within SMEs in Indonesia, however, there is no study analyze about lean production practice and industry 4.0 implementation in Indonesia SMEs.

The results of this study revealed that within Indonesia SMEs there were positive and simultaneous influences on lean production practices and industry 4.0 implementation. Influence in industry 4.0 implementation exception product design, the majority of respondents are SMEs who have never conducted research and development for their production.

Keywords: *Lean production, Industry 4.0, SMEs in Indonesia*

Introduction

Lean manufacturing is considered the best practice in the cycle of manufacturing (Rose et al., 2011). “The occurrence of industry 4.0 is to improve efficiency, add value, refine the process, and be beneficial to reach the principle of sustainability (Torterella and Fettermann, 2018). Industry 4.0 is the most recent concept and popular between industry and scholars’ academic. Industry 4.0 is considered to be the rise of new digital industrial technology (Lorenz et al., 2015). The link in the implementation of industry 4.0 and lean production creates effective

results in business performance because industry 4.0 will make a significant revolution on the business models of how to design, manufacture, and deliver the products or services (Dalenogarea et al., 2018). Concerning this, SMEs have to work hard to improve their effectiveness in the industrial
management processes such as planning, resource use, production control, measurement, and evaluation of operational performance (Moeuf et al., 2018). The expected contribution of Industry 4.0 technology to industrial performance shows how the adoption of different Industry 4.0 technologies is associated with the expected benefits from pro-product aspects, operations, and side effects. Several studies are investigating the relationship between industry 4.0 and lean manufacturing (Munteanu et al., 2018; Dalenogarea et al., 2018).

A study on the linkage between industry 4.0 and lean production shows evidence that the higher adoption rate of industry 4.0 makes it easier to achieve lean production in high implementation in enterprises. Companies aiming to achieve a higher level of industry 4.0 have implemented a certain level of lean production practices (Rossini et al., 2019). Another study states that the integrated implementation of industry 4.0 and lean production enables companies to overcome traditional barriers in the lean transformation to achieve big results. Organizational structures and processes including human resource management in lean production must be supportive (Sanders et al., 2016; Haseeb et al., 2019). A special study of small and medium enterprises revealed that industry 4.0 is the key to SME business growth where industrial elements such as big data, the internet of things, and smart factories play a positive role in advancing information technology. The main challenge for SMEs in Indonesia in implementing industry 4.0 is related to lean production where the manufacturing sector is dominated by local SMEs with limited technology adoption (Manufacturing Indonesia, 2019).

A study on the interrelation between industry 4.0 and lean production showed evidence that higher levels of industry 4.0 adoption led to easier to achieve lean production in a high implementation in the firm. Companies that aim at achieving higher levels of industry 4.0 have implemented a certain level of lean production practices (Rossini et al., 2019). Another study states that the integrated implementation of industry 4.0 and lean production allows companies to overcome traditional barriers in the lean transformation to achieve major results. The structure and process of the organization include human resource management in lean production must be supportive (Sanders et al., 2016; Haseeb et al., 2019). Specific studies on small and medium-sized enterprises reveal that industry 4.0 is key to the growth of SMEs business which elements of industry such as big data, the internet of things, and smart factories have a positive role in promoting information technology. The key challenge for SMEs in Indonesia in the implementation of industry 4.0 is related to lean production where the manufacturing sector is dominated by local SMEs with limited technological adoption (Manufacturing Indonesia, 2019).

This study attempts to analyze factors in lean production practices such as management and human resources and industry 4.0 contributing to SMEs in Indonesia. Thus study, Therefore, states this case in the problem statement. There have been few studies on the importance of lean production and industry 4.0 in SMEs, some studies also analyze the importance of lean manufacturing in SMEs, industry 4.0 challenge for SMEs in Indonesia, however, some studies analyze the importance of lean manufacturing for SMEs in Indonesia and the challenge of implementation industry 4.0 for SMEs in Indonesia, separately. However, there is no study analyzing implementing lean production for industry 4.0 in Indonesian SMEs. Recently Indonesia is in the second level from the fifth level of industry 4.0. Therefore, Indonesia needs to upscale to higher from SMEs perspective, they still lack awareness of this condition industry (Kementrian Perindustrian RI, 2019). On another side, the level of industry 4.0 can be upscale by implementing lean production (Rossini et al., 2019). Therefore, SMEs in Indonesia need to be convinced that there is a relation between lean production implementation and industry 4.0 practice. This study aims to descript SMEs in Indonesia in concerning relation to lean production and industry 4.0 so that SMEs realize the importance of their part to support industry 4.0 in Indonesia to a higher level.

1.1 Problem Statement

Most businesses that adopt Lean of SMEs in Indonesia are not taking advantage of the changes sufficiently. Some industrial business is unaware of the method that can use for professional growth and environmental change.

1.2 Research Objective

To examine the practice of industry 4.0 and lean production implementation in Indonesia SMEs, therefore the result could be used to identify the aspect of industry 4.0 which is affecting lean production, identify their roles in the business performance and give direction to the business practices in implementing industry 4.0 for Indonesia SMEs.

1.3 Research Questions

Is there a positive and significant between lean practices and the industry 4.0 adoption within SMEs in Indonesia and how the degree of the lean production indicators influences the industry 4.0 as enablers within SMEs in Indonesia?

1.4 Research Method

This study utilized mix methods (quantitative and qualitative) approach and is often referred to as a methodology that provides deep philosophical assumptions indicating directions or providing directions for data collection and analysis, as well as a combination of quantitative and qualitative approaches. This study interview and deliver questionnaires to the owners, directors, managers and acting managers from twenty-five SMEs in Indonesia.

1.5 Aims and Benefit

This study aims to find out the influence of lean production practices and industry 4.0 of SMEs in Indonesia. Besides, this study presents new research by looking into lean production practices and industry 4.0 implementation to the benefit of the business performance of SMEs in Indonesia. This study using mix methods (quantitative and qualitative) approach. Furthermore, this paper will bridge the gap between the efforts to identify aspects of industry 4.0 contribution to lean manufacturing and their roles to the business performance of SMEs in Indonesia and give direction to the business practices in implementing industry 4.0.

1.6 Research Scope

The study focuses on SMEs in Indonesia and utilizes the sample from twenty-five different SMEs in Indonesia implementing Lean Production practices on industry 4.0.

1.7 Research Limitation

The study is experienced limitations wherein Indonesian SMEs is relatively difficult to absorb more data from various industries implementing Lean production practice and industry 4.0. Nevertheless, the researcher could not able to collect the data as intended. “Therefore, future work should include more samples from greater Indonesian SMEs which currently implementing industry 4.0.

Lıterature Revıew

2.1 Lean Production

Lean production is an approach that is widely considered and spread across several industries that aims to reduce waste and increase productivity and quality according to customer requirements (Womack et al., 2007; Jasti and Kodali, 2015). Lean production implementation means a human-centered systematic approach of various management principles and practices (Seppala and Klemola, 2004).

There are six indicators (Iranmanesh et al., 2019) use in this study as a framework of lean practice. The study uses these six lean production indicators as they are considered to answer the hypotheses stated in this study. These are the following indicators,

2.1.1 Equipment and Methods.

Equipment and methods are the typical processes of innovating capability and practices, including the use of "error-proof" equipment, minimizing cycle times, quality and performance of machinery, using cellular manufacturing, and shortening the time to achieve regular and consistent flows within production processes.

2.1.2 Manufacturing Planning and Control

The activities of planning and monitoring result in a reduction in the products and components used throughout the process of production, without disrupting the delivery time. Compared to traditional production, lean planning and monitoring greatly lead to waste scheduling and reductions in the use of raw materials and workforce, which are the major waste areas.

2.1.3 Human Resources Practices

Human resource activities focus on supporting lean goals through the development of human resources and the creation of the working climate in a proper way. It implicates the workers’ empowerment, self-managed work teams, involvement, collaborative problem solving, recognized training programs, and problem-solving groups. Sustained quality improvement strategies are highly dependent on human resources that are the basis of effective lean manufacturing applications.

2.1.4 Product Design

Product design refers to activities such as multifunctional design teams, industrial design, modularization of products, and standardization of components. The objective of product design activities is to optimize the research and development process by reducing the volume of material used in a product streamlining the fabrication and production process and thus maximizing the use of the resources of companies.

2.1.5 Supplier Relationship

The supplier relationship relates to the degree to which the supplier works to resolve quality issues and ensure just-in-time delivery by taking into account the number of suppliers, long-term relationships, and supplier participation in the product development and design process and by giving feedback on the performance of suppliers.

2.1.6 Customer Relationship

Relationships with customers refer to how businesses communicate with customers to create long-term customer relationships, enhance consumer satisfaction and handle complaints from customers. Close contact with consumers, participation in product design and exchange of information with customers as customer relationship activities contribute to the recognition of customer needs and ultimately the preservation of customer loyalty through product, service, and separation of processes from rivals and efforts to add value.

2.2 Industry 4.0

Industry 4.0 describes a form of production that meets the high effectiveness and information interface where all machines and products are digitally networked together. Industry 4.0 technology should improve the transmission of information across systems to enable better controls and operations to be adapted in real-time according to different demands. New technologies such as cloud computing, the internet of things, cyber-physical systems, and big data (Moeuf et al., 2018). The adoption of industrial technology 4.0 is considered as a strategy to improve product quality and manufacturing process efficiency. However, industries need to investigate the processes they can support and how these technologies are integrated into existing production systems (Tortorella & Fettermann, 2018). The application of automation equipment improves product quality while occupying the manufacturing process more efficiently (Landscheidt and Kans, 2016). During this period, it was explained that further development and integration of digital production automation by utilizing electronics, information technology, and industrial robots was carried out to integrate computer manufacturing systems (Kagermann et al., 2013). Cyber-Physical systems entitle the production system to be substituted and converted to produce highly customized products in mass production. It is still under investigation as to which industrial 4.0 modes of technology are consolidated into existing production systems and which activities they can assist with (Kolberg et al., 2017).

2.2 The role of Lean in Industry 4.0

"The role of lean production practices and industry 4.0 has been symbolized as Lean Automation (LA) to achieve higher change and shorter information flows to meet future market demands (Kolberg and Zuhlke, 2015). Lean production is a complement to the technological point of view emphasized in Industry 4.0 because Lean production and Industry 4.0 prefer simple and decentralized structures over large and complex systems while aiming for small and easy-to-integrate modules with lower levels of complexity (Zuhlke, 2010). However, some debates say contradictory evidence found in the literature suggests that the understanding of this association and its impact on operational performance still needs to be deepened and better explored (Schumaker et al., 2016).

2.4 Nine Major Pillars of Industry 4.0

There are nine pillars of modern technological progress, the foundation of industry 4.0. These nine pillars help transform the operational potential of the manufacturing sector (Rüßmann et al., 2015; Erboz, 2017)

2.4.1 Big Data and Analytics

In the industrial world, there are sets of untapped data. Big data and analytics optimize production quality, energy savings, and services improvement. The goal of big data and analytics is to allow real-time decision-making.

2.4.2 Augmented Reality

Augmented reality provides operators the real-time information for faster decision-making and improves work processes.

2.4.3 Simulation

The simulation consists of three development simulations. They are the simulation of product development, material development, and Production process. Simulation leverages real-time data to reflect the physical world in virtual models of machines, products, and people. Operators will test and optimize machine settings for the next product even before production starts. Therefore, simulation reduces machine setup time and improves.

2.4.4 Internet of Things

The industrial internet of things (IoT) enables a greater number of products to incorporate intelligence and connect using standard protocols. This situation leads to analytics decentralization and decision-making. Thus, it enables real-time responses.

2.4.5 Cloud Computing

Industry 4.0 in the process of operations needs more data sharing. Cloud technology performance improves and achieves response times of mere milliseconds. Greater number of manufacturing execution systems based on cloud-stored machine data.

2.4.6 Cybersecurity

Cybercrime’s threat is a critical issue in industry 4.0. Therefore, there is a critical issue to protect information systems and manufacturing lines. It is necessary to have sophisticated identity and machine-access management systems to provide security and reliable communication.

2.4.7 Systems Integration

Industry 4.0 system integration, companies, departments, organizational functions, suppliers, and customers become more cohesive and connected. Horizontal and vertical integration of systems, knowledge, and information will be easy to implement throughout the supply chain and enhance collaborative efforts across all production and research and development lines, customers, and suppliers.

2.4.8 Additive Manufacturing

In industry 4.0 additive manufacturing such as 3D printing is used to produce smaller batches of customized products with complex designs, more prototypes, and old replacement parts.

2.4.9 Autonomous System

One of the most important features of industry 4.0 is autonomy. Robots are more autonomous, flexible, and cooperative capable of performing complex tasks. Monitoring, operation, and programming to coexist and operate as a human task. The cost of maintaining the robot is reduced which means the opportunity to occupy it is more reliable.

SMEs in Indonesia are currently in the early stages of readiness to enter the era of the technology industry 4.0. Industry 4.0 in Indonesia is on average level 2, out of all 5. Level 0 means the industry is not ready to transform into industry 4.0, level 1 is the initial readiness stage, level 2 is the medium readiness stage, level 3 is the mature stage of the readiness stage, and 4 is the readiness stage to run and level 5 means the industry has implemented industry 4.0 (Ministry of Industry of the Republic of Indonesia, 2019). The Indonesian government launched a measurement indicator in the application of a technology called Indonesia Industry 4.0 or INDI 4.0 which was used to measure the level of readiness of industry 4.0. The five indicators used in INDI 4.0 are Management and Organization, People and Culture, Product and Service, Technology, and Factory Operation, these efforts help companies transform digitally to support industry 4.0. (Indonesian Manufacturing, 2019). The industry is still considered to be using conservative methods and the lack of knowledge and skills about lean is causing development and implementation failures (Ministry of Industry of the Republic of Indonesia, 2019). Therefore, this study tries to expand these indicators by applying six indicators of lean practice.

Five indicators in INDI 4.0 are derived from Lean production practices, are;

Management and organization refer to Human Resources Practices, Supplier and Relation

People and Culture refer to Customer Relation

Product and Service refer to Product Design

Technology refers to Equipment and Methods

Factory refer to Manufacturing Planning and Control

The Five indicators used in INDI 4.0 are Management and Organization, People and Culture, Product and Service, Technology, and Factory Operation, the effort assists companies to transform digitally to support industry 4.0 (Manufacturing Indonesia, 2019). It is considered to be well connected and implemented with four pillars of industry 4.0 as known as the Internet of Things (IoT), System of Integration, Cloud Computing, and Cyber Security.

2.5. Small Medium Enterprise in Indonesia

The number of SMEs in 2014-2016 was over 57 million, the number of SMEs is expected to grow was over 59 million units in 2017 and during the COVID-19 pandemic, the growth of Indonesian SMEs has persisted and even shown an increase of over 64 million. (Kementerian Keuangan RI, 2020).

From 64 million units of SMEs, Indonesia has three popular SMEs businesses. The first one is Wholesale and retail trade with 52.42%, the second is a provision of accommodation, food, and beverages with 25.93% and the third is industry processing 21.65% which consists of food and beverages with 8,6%, textiles, and clothes 5.7%, wood and wicker with 3.7%, textiles, floor, and cement with 2.4% and furniture with 1.25 %.

Small and medium enterprises in Indonesia called Usaha Kecil dan Menengah, (UKM). In Indonesia, the country's definition of small and medium enterprises was set out in the small enterprise act No.9 of 1995 with definitions:

(a) A business that owns net assets worth 200 million rupiahs or less. The assets shall not include land and

building

(b) Owned by Indonesian

(c) Annual sales are 1 billion rupiahs or less

(d) An independent economic entity which means that it is not a subsidiary or a branch of large or medium

enterprise, direct or indirect controlled by large enterprises
(e) Business run by an individual a non-corporate entity or a cooperative organization.
In 2008, the act of definition (act. 20 of 2008) was revised as follows: a micro-enterprise based on traditional industry and small enterprises are managed privately, and medium enterprises have net assets between 500 million and 10 billion rupiahs"

2.6 Previous Research

Analyzing the perceived incomplete relationship between Industry 4.0 and lean manufacturing investigates whether Industry 4.0 is capable of implementing lean. Implementing Industry 4.0 is a cost-consuming operation and encounters reluctance from some manufacturers, the study discusses that lean manufacturing is widely regarded as a potential methodology for increasing productivity and lowering costs in manufacturing organizations, the study discusses that lean manufacturing is widely regarded as a potential methodology for increase productivity and reduce costs in manufacturing organizations (Scroder, 2016). The success of lean manufacturing demands a consistent and conscious effort from the organization and has to overcome several hurdles (Dalenogarea et al., 2018).
Exploring the challenges of industry 4.0 for small and medium-sized businesses that concludes the economic potential of network production in terms of Industry 4.0 is already visible in the basic technology available today. To make this happen, small and medium-sized enterprises need a flexible organizational structure because business fields that are currently separate from each other are increasingly becoming interconnected (Scroder, 2016). The industrial stage where vertical and horizontal integration of manufacturing processes and product connectivity can help companies achieve higher industrial performance. However, little is known about how the industry sees the potential contribution of technology related to Industry 4.0 to industrial performance, especially in developing countries". (Dalenogarea et al., 2018).

2.7 Conceptual Framework

The concept of the framework aims is to find out the relationship between lean and industry 4.0 partially and simultaneously. As shown in Figure 1 below. This study used SPSS (Statistical Package Social Sciences) 22.0 version.

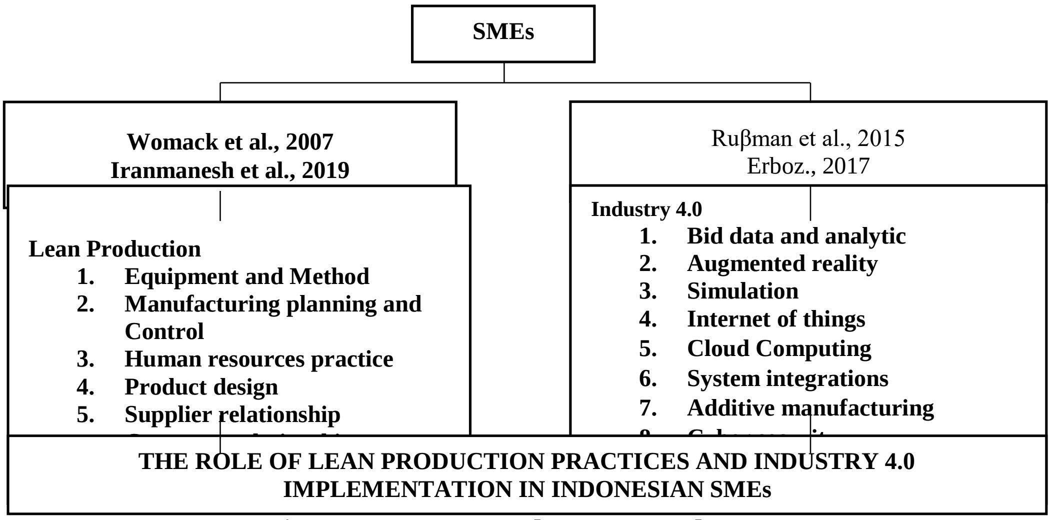

Figure 1 Conceptual Framework

Research Methodology

3.1 Research Design

This study uses the research object i.e., Owner, Director, Manager, and Acting manager at twenty-five SMEs in Indonesia using mixed methods of explanatory approach analysis. Mixed Methods is an approach based on the analysis method on philosophical assumptions. Mixed methods are often referred to as a methodology that provides deep philosophical assumptions indicating directions or providing directions for data collection and analysis, as well as a combination of quantitative and qualitative approaches. The main premise is that mixed research methods are focused on a mixture of quantitative and qualitative approaches for better research than if only one approach is used (for example, with only a quantitative approach or with only a qualitative approach). When solving research issues, the mixed-method analysis provides information more accurately, whereas quantitative and qualitative data collection instruments are limited to certain types.

This method explores scientific research results covering different industry 4.0 issues and industry implementation in lean production in the real business performance of SMEs in Indonesia. The study used questionnaires distribute to SMEs in Indonesia, implementation, and interviews to collaborate the data to enrich research analysis output. The questionnaires will discuss the association and the impact of lean production practices, the adoption level of 4.0 implementation. The interviews were implemented to describe the data that is not covered in the questionnaire.

The empirical method is used to identify the relationship between lean production practices and industry 4.0 implementation in the Small Medium Enterprises business in Indonesia. Furthermore, this study explores scientific research results covering different industry 4.0 issues and industry implementation in lean production in SMEs.

3.1.1 Hypotheses Framework

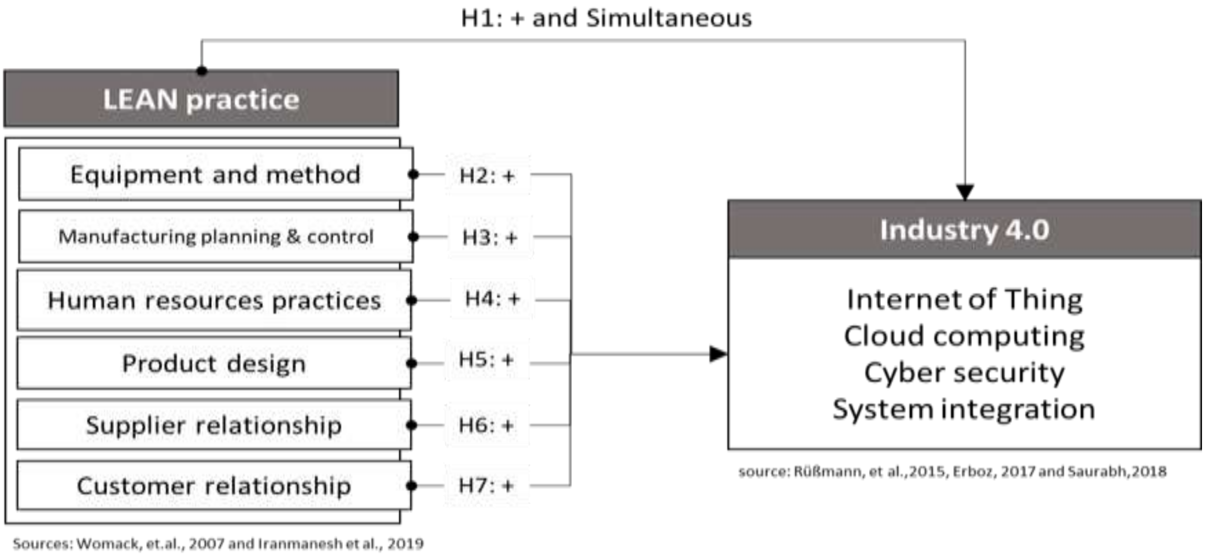

Figure 2 framework of Hypotheses

3.1.2 Hypotheses Methodology

The hypotheses proposed in this study are as follows:

H1: There is simultaneously and positive influence between lean practices and the industry 4.0
in Indonesia SMEs

H2: There is a positive influence between equipment and methods on industry 4.0
in Indonesia SMEs

H3: There is a positive influence between manufacturing planning and control on the industry 4.0
in Indonesia SMEs

H4: There is a positive influence between human resources practices on industry 4.0 in Indonesia
SMEs

H5: There is a positive influence between product design on the industry 4.0 in Indonesia SMEs

H6: There is a positive influence between supplier relationship on the industry 4.0 in Indonesia
SMEs

H7: There is a positive influence between customer relationships on industry 4.0 in Indonesia SMEs

3.1.3 Methodology Flow Chart

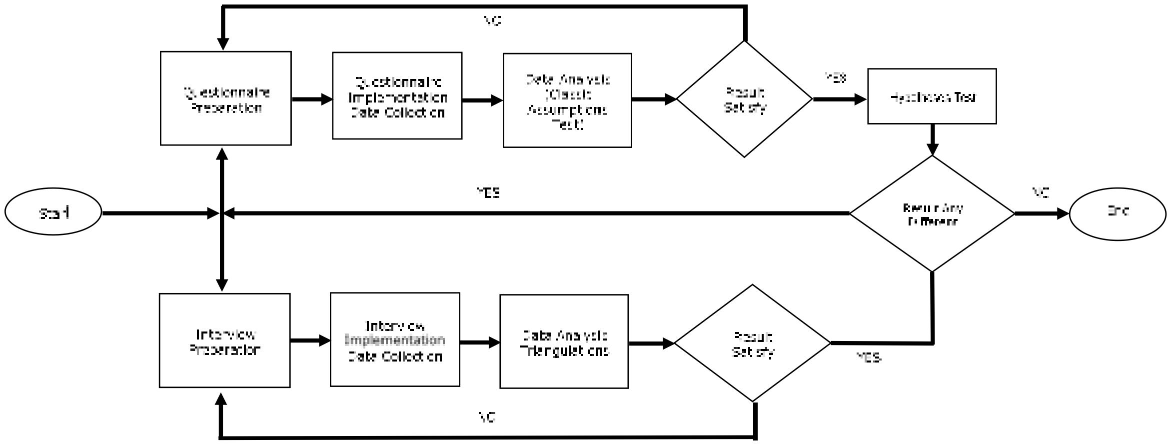

Figure 3 Flowchart of Methodology

The method explores scientific research results covering different industry 4.0 issues and industry implementation in lean production in the real business performance of SMEs in Indonesia. The study used questionnaires distribute to SMEs in Indonesia, implementation, and interviews to collaborate the data to enrich research analysis output. The questionnaires will discuss the association and the impact of lean production practices, the adoption level of 4.0 implementation. The interviews were implemented to describe the data.

that is not covered in the questionnaire, hypothesis testing is one of the uses of inferential statistics used in statistical methods, it can be seen whether an assumption or statement is supported or not based on data that has been previously processed. This questionnaire of two parts namely questions related to lean practice and related to industry 4.0 practice. The research uses questionnaires about lean production followed the six indicators of lean practice (Iranmanesh et al., 2019; Womack et al., 2007).

Table 1. Consideration of Determining Questions

No	Indicator	Question	Reason
1	Equipment and Method	Involvement of senior level in HSE management. Promotion a positive culture toward the HSE matrix. HSE document.	This three-question similar to SOP and scheduled and preventive maintenance -
2	Manufacturing planning and Control	Involvement of senior managers in production planning and control. The use of information technology in industry 4.0 to improve production logistics. Implementation of MRP (Materials Requirement Planning).	Still lack information technology in SMEs in Indonesia

3	Human Resource Practice	Selection of candidates Budget for training Leadership style	SMEs usually do not want to provide information about recruitment, financial and leadership style cannot be in question because the questionnaire is designed for the top level.
4	Product Design	R&D for new product The quality of the product Teamwork to process design	The majority of SMEs do not have an R&D unit for doing product design, for product design the make out-sourcing to another factory
5	Supplier Relationship	Involvement in developing SCM (Supply Chain Management) Pursuing SCM practice Logistic issues factor after SCM practice	The three questions were similar to the questionnaire of this study
6	Customer Relationship	Structure of sales team and customer organization. Company best team performance compares to the competitor. Customer relations are given great value.	SMEs usually do not want to provide information

However, not all questions of previous research could be applied in the questions of questionnaires in this study because they were not suitable for the Indonesia case or duplicated with other questions and have been discussed with several SMEs leader who was respondents. The following is an explanation of why the questions from Iranmanesh were not all included in this questionnaire, in this questionnaire for each indicator in Table 1. Therefore, the researcher feels sufficiently represented by using only three questions of questionnaires.

3.2 Data Collection

"The data collection used for the quantitative approach is a survey methodology, a test that uses a questionnaire as a method to gather basic data and observations to describe certain results arising from the analysis of the data collected. The data obtained by the questioner is then modified using a Likert scale to assign each question a weighting score. The Likert scale is used to measure a person's or group of people's attitudes, opinions, and perceptions

(Sugiyono, 2017). Likert scale's weighting score: strongly agree (5); agree (4); neutral (3); disagree (2), and strongly disagree (1).

The interview is one method that can be used to collect research data for analysis. Simply stated that the interview (interview) is an event or interaction process involving direct communication between the interviewer (interviewer) and the source of information or the individual being questioned (interviewee). The interview approach is also the procedure between the interviewer and the respondent being questioned, with or without the use of interview guidelines to obtain information for research purposes utilizing question and answer face to face. Normally it is performed separately or in a team format in these interviews so that details can be authentic.

3.2.1 Respondent and Informant

The study uses primary and data sources from twenty-five of SMEs in Indonesia that incorporate lean manufacturing in their operations and start implementing and applying the concepts of industry 4.0. Operating and start implementing and applying the concepts of industry 4.0. Operation managers at these organizations are the main respondents and informants.

3.3 Data Analysis

This study using SPSS (Statistical Package Social Sciences) 22.0 version to analyze the data. The analysis including validity test, reliability test, normality test, multicollinearity test, heteroscedasticity test, and hypothesis test.

3.3.1 Validity Test

Reliability indicates to what degree a measurement device will assess what you want to measure. Also, knowing the extent to which the data collected does not deviate from the description of the intended variable. The questionnaire used is expected to function as accurate data and can be trusted to exist. A questionnaire is considered valid if the question items must express something that the questionnaire would measure whilst the questionnaire used can function as an instrument used to measure data accurately. (Pribadi, 2011 and Arikunto, 2016). The formula is as follows:

$$r_{xy} = \frac{N \cdot \Sigma X \cdot Y - (\Sigma X)(\Sigma Y)}{\sqrt{(N \cdot \Sigma X^2 - (\Sigma X)^2) \cdot (N \cdot \Sigma Y^2 - (\Sigma Y)^2)}} \quad (3.1)$$

r_{xy} is the coefficient of correlation between the score of X and Y score

N is the number of participants

Y is the standard deviation score total

$\sum X$ is the total score of X

$\sum Y$ is the total score of Y

The Basic decision-making of the validity test is if the Sig. (2-tailed) < 0.05 and Pearson correlation are positive, if the statement is valid, however, if the Sig. (2-tailed) > 0.05 and Pearson correlation are negative, then the statement is invalid.

3.3.2 Reliability Test

Reliability testing is conducted to determine the extent to which a measuring device can be trusted and relied upon. Reliability is an evaluation that can show a measuring instrument's level of stability and consistency in the sense that the measurement obtained is still the appropriate calculation of a measuring instrument. The objective is to decide to what degree measurements can produce consistent results when they are done twice or more on the subject using the same measuring instrument (Pribadi, and Arikunto, 2016). An important requirement that must be fulfilled by the questionnaire is that it is reliable with the intention that someone answers a question consistently over time.

The formula Alpha Cronbach is as follows:

$$r_{11} = \left[\frac{\text{n}}{\text{n}-1}\right]\left[1 - \frac{\sum \sigma_b^2}{V_t^2}\right] \quad (3.2)$$

r_{11} is the instrument reliability
N is the number of participants
$\sum \sigma_b^2$ are several variants
V_t^2 are several statements

The basic decision-making of the reliability test is if the Alpha value of Cronbach is > 0.70, the questionnaire will be declared reliable or consistent, conversely, if the Alpha value of Cronbach is < 0.70, the questionnaire is considered unreliable or inconsistent.

3.3.3 Classic Assumption Test

A multiple linear regression model (multiple regression) is called a good model if the model fulfills several assumptions, which are then referred to as classic assumptions. The classic assumption testing process is carried out together with the regression testing process so that the steps are taken in the classical assumption test use the same working steps as the regression test (Sugiyono, 2017). Five assumption tests must be performed on a regression model that is the multicollinearity test, normality test, heteroscedasticity test, hypotheses test, and triangulation.

3.3.3.1 Multicollinearity Test

The multicollinearity test is used to check whether there is a correlation in the regression model between the independent variables. No association between independent variables must exist in a good regression model. If it is proven that there is multicollinearity, the independent one should be is removed from the model, then the regression model is measured again. To detect the presence or absence of multicollinearity can be seen from the amount of Variance Inflation Factor (VIF) and Tolerance.

Decision-making recommendations focused on VIF, if the VIF value < 10.00 the regression model does not have multicollinearity, but if the VIF value > 10.00 the regression model does have multicollinearity.

Decision-making criteria based on the values of tolerance is if the tolerance value > 0.10, the regression model does not have multicollinearity, but if the tolerance value is < 0.10, the regression model does have multicollinearity.

3.3.3.2 Normality Test

Normality Test is a statistical test conducted to determine the distribution of the data the first condition is normality in parametric statistics such as regression and ANOVA. The purpose of the normality test is to check whether the intruder or residual variable has a normal distribution in the regression model. If this assumption is violated, especially for small samples, the statistical test becomes invalid or biased. Guidelines for taking decisions on normality tests using P Plot chart: the normality test of a data is measured by spreading data (points) on its diagonal axis. If the data depth around the diagonal line and follows the diagonal line direction, the data will be declared normally distributed. Data is not normally distributed if the data is spread far away from the direction of the line and does not follow the diagonal line direction.

3.3.3.3 Heteroscedasticity Test

The heteroscedasticity test aims to test whether, in a regression model, variance or residual inequalities occur from one observation to another, the Spearman rank test is used to check the nature of heteroscedasticity, which is to compare the independent variable with the absolute residual value (error). To detect the symptoms of the heteroscedasticity test, a regression equation is made with the assumption that there is no heteroscedasticity and then determines the absolute value of the residual, then regresses the absolute residual value obtained as the dependent variable, and regression of the independent variable is made. If the correlation coefficient between the independent variable and the absolute value of the residuals is significant, then the conclusion is heteroscedasticity (a variant of the inhomogeneous residual).

The formula is as follow:

$$\chi^2 = n \cdot R^2 \cdot k \quad (3.3)$$

n is the number of participants

R^2 is the coefficient of determination based on a possible linear regression

k is represents the number of independent variables.

The basis for the Spearman Rank heteroscedasticity test decision-making is If the Sig. (2-tailed) > 0.05, then there is no heteroscedasticity problem, conversely if the value of Sig. (2-tailed) < 0.05 then there is a heteroscedasticity problem.

3.4. Hypotheses Test

Hypotheses are statements that describe the relationship between two variables related to a particular case and are temporary assumptions that need to be tested true or not true to the allegations in the analysis and have the advantage for the research process to be effective and efficient. Test the hypothesis is to look at the relationship between the two variables, the null hypothesis (Ho) is generally formulated to be rejected, while the alternative hypothesis (Ha) is the hypothesis proposed in this study. hypotheses in this research will use F-test and t-test.

3.4.1 F-test

F test is performed to see how the effect on the dependent variable of all independent variables together. The F-test formula is as follow:

$$F = \frac{R^2/(K-1)}{(1-R^2)/(n-K)} \quad (3.4)$$

R^2 is the coefficient of determination based on a possible linear regression

K is represents the number of independent variables

n is the number of participants

Decision-making guidelines in the F-test are as follows: If the Sig. (ANOVA output) < 0.05 then the hypothesis is accepted, variable X simultaneously influences variable Y, and conversely, if the Sig. (ANOVA output) >0.05, the hypothesis is then rejected variable X does not influence the Y variable simultaneously.

Decision making is based on the comparison of F-count value with F-table: If f-count > f-table's value, the variable X influences variable Y simultaneously, and otherwise if the value of F-count < F-table, then the variable X does not influence the variable Y simultaneously.

3.4.2 t-Test

The t-test is known as a partial test, which is to test how the influence of each independent variable individually on the dependent variable. This test can be done by comparing the t-count with the t-table or by looking at the column of significance on each t-count.
The formula is as follow:

$$t = \frac{r\sqrt{(n-2)}}{\sqrt{1-r^2}} \quad df = n-2 \tag{3.5}$$

r is the coefficient correlation
n is the number of participants
Criteria:
Ho: Variable X is not partially influenced variable Y, hypotheses are rejected.
Ha: Variable X partially influences variable Y, hypotheses are accepted.
Guidelines for making t-test decisions: if the value of Significance (Sig) < 0.05 and t-count > t-table, then variable Y is influenced by variable X or the hypothesis is accepted and if the Sig. > 0.05 and t-count < t-table, there is no influence of variable X on variable Y or the hypothesis rejected.

3.4.3 Coefficient of Determination (R Square)

The determination coefficient is used to measure the independent variable's ability to explain the dependent variable. The determination coefficient is reflected in the proportion of variation that can be explained by the independent variable in the dependent variable. With the formula below:

$$cd = R^2.100\ \% \tag{3.6}$$

R^2 is the coefficient of determination based on a possible linear regression
The value of the determination coefficient is between 0-1. If the value of the determination coefficient is close to 1, it will increase the influence of the independent variable on the dependent variable. If, on the other hand, the value of the determination coefficient is close to 0, the influence of the independent variable on the dependent variable becomes weaker.

3.5 Triangulation

The method of triangulation is used to comparing information or data in different ways. In qualitative research, researchers used interviews, observation, and survey methods. To obtain reliable truth information and a complete picture of certain information, researchers can use interview and observation or observation methods to check the truth. Besides, researchers can also use different informants to check the truth of the information. Triangulation of this stage is done if the data or information obtained from the research subject or informant is in doubt".

Results And Dıscussıon

This chapter describes the results of questionnaires and interviews in twenty-five companies in Indonesia. The analysis of the result of this study is divided into six sections are Participating Companies, Validity Test, Reliability Test, Classic Assumption Test, Hypotheses Test, Triangulation Data (Result of Interview), and one section for discussion. This study used SPSS 22.0 software to analyze the data. 103 questions were applicable to use for the study.

4.1.1 Respondent Demographics

Participating respondents were then categorized as follows:

10 or 9.71% of respondents aged 20-30, 51 or 49.51% of respondents aged 31-40, 25 or 24.27% of respondents 41-50 years old, and 17 or 16.50% of respondents over 50 years old. 2 participants, or 1.94% of respondents, are high school graduates, 69 or 66.99% are undergraduates, 31 or 30.10% are Masters and 1 participant or 0.97% are Ph. D./Postdoc, 100 or 97.09% of male respondents and 3 or 2.91% of female respondents.

2 participants or 1.94% of respondents worked for 3-10 years, 65 or 63.11% of respondents employed for 11-20 years, 23 or 22.33% of respondents served for 21-30 years, and 13 or 12.62% of respondents employed for more than 30 years. 11 or 8.45% of the respondent acting manager level, 64 or 63.85% of the respondent manager/senior manager level, 17 or 10.77% of the respondent director level, and 11 or 16.92% of the respondent owner level.

4.2 Validity Test

The results of the validity test for lean production (variable X) are in “Table 4, where X_1 is equipment and method, X_2 is manufacturing planning and control, X_3 is human resources practice, X_4 is product design, X_5 is supplier relationship, and X_6 is the customer relationship.

Table 4. Validity Test result (Variable X)

Correlations

		X_1	X_2	X_3	X_4	X_5	X_6	Lean Practice
X_1	Pearson Correlation	1	.686**	.585**	.456**	.630**	.202**	.815**
	Sig. (2-tailed)		.000**	.000**	.000**	.000**	.000**	.000**
	N	103	103	103	103	103	103	103
X_2	Pearson Correlation	.686**	1	.579**	.440**	.548**	.124*	.784**
	Sig. (2-tailed)	.000**		.000**	.000**	.000**	.211*	.000**
	N	103	103	103	103	103	103	103
X_3	Pearson Correlation	.585**	.579**	1	.651**	.489**	.283**	.779**
	Sig. (2-tailed)	.000**	.000**		.000**	.000**	.004**	.000**
	N	103	103	103	103	103	103	103
X_4	Pearson Correlation	.456**	.440**	.651**	1	.501**	.224*	.730**
	Sig. (2-tailed)	.000**	.000**	.000**		.000**	.023*	.000**
	N	103	103	103	103	103	103	103
X_5	Pearson Correlation	.630**	.548**	.489**	.501**	1	.319**	.809**
	Sig. (2-tailed)	.000**	.000**	.000**	.000**		.001**	.000**
	N	103	103	103	103	103	103	103
X_6	Pearson Correlation	.202*	.124*	.283**	.224*	.319**	1	.339**
	Sig. (2-tailed)	.000**	.211*	.004**	.023*	.001**		.000**
	N	103	103	103	103	103	103	103
Lean Practice	Pearson Correlation	.815**	.784**	.779**	.730**	.809**	.339**	1
	Sig. (2-tailed)	.000**	.000**	.000**	.000**	.000**	.000**	
	N	103	103	103	103	103	103	103

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The results of the validity test for industry 4.0 (variable Y) are in Table 5, where Y_1 is the internet of things, Y_2 is cloud computing, Y_3 is cybersecurity, and Y_4 is system integration.

Table 5. Validity Test result (Variable Y)

Correlations

		Y_1	Y_2	Y_3	Y_4	Industry 4.0
Y_1	Pearson Correlation	1	.708**	.572**	.571**	.858**
	Sig. (2-tailed)		.000**	.000**	.000**	.000**
	N	103	103	103	103	103
Y_2	Pearson Correlation	.708**	1	.649**	.556**	.870**
	Sig. (2-tailed)	.000**		.000**	.000**	.000**
	N	103	103	103	103	103
Y_3	Pearson Correlation	.572**	.649**	1	.477**	.807**
	Sig. (2-tailed)	.000**	.000**		.000**	.000**
	N	103	103	103	103	103
Y_4	Pearson Correlation	.571**	.556**	.477**	1	.791**
	Sig. (2-tailed)	.000**	.000**	.000**		.000**
	N	103	103	103	103	103
Industry 4.0	Pearson Correlation	.858**	.870**	.807**	.791**	1
	Sig. (2-tailed)	.000**	.000**	.000**	.000**	
	N	103	103	103	103	103

**. Correlation is significant at the 0.01 level (2-tailed).

It is known from Table 5 and Table 6 that all Pearson correlation values of variables X and Y are positive and Sig. (2-tailed) < 0.05 based on the results of the validity test in the table above. This is consistent with the basic decision-making that states If the Sig. < 0.05 and Pearson Correlation is positive, then the item claim is relevant to enable reliability testing of the instrument items.

4.3 Reliability Test

The results of the reliability test and the reliability statistics in Table 6, the reliability coefficient (Cronbach's Alpha) value per variable was 0.837 for Lean production practice (X) and 0.850 for Industry 4.0 (Y). The test results are consistent with the reliability test's basic decision-making, which states that if Cronbach's Alpha value is > 0.70, the questionnaire will be declared reliable or consistent. The results of the reliability test can be continued to carry out in the next test, i.e. the classical assumption test.

Table 6. Reliability Test result

Case Processing Summary

		N	%
Cases	Valid	103	100.0
	Excluded	0	.0

Total	103	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Variable	Cronbach's Alpha	N of Items
X	.837	6
Y	.850	4

4.4 Classic Assumption Test

After validity and reliability testing and validity and reliability of the test results obtained from each instrument, then the classic assumption test consisting of multicollinearity, normality, and heteroscedasticity analysis is performed.

4.4.1 Multicollinearity Test

The multicollinearity test is performed by the results of the test in Table 7.

Table 7. Multicollinearity Test result Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	61.391	5.212		11.779	.000		
	Lean Practice	.130	.068	.188	1.919	.058	1.000	1.000

a. Dependent Variable: Industry 4.0

Based on Table 7, the VIF calculation results show that the value of the independent variable is < 10 and the value of the tolerance matrix > 0.10. It implies that, according to decision-making guidelines, there is no multicollinearity between independent variables in the regression model which specifies that if the VIF value < 10.00 and if the tolerance value > 0.10, there is no multicollinearity in the regression model.

4.4.2 Normality Test

The next step after multicollinearity testing is to conduct a test of normality with the test results as shown in Figure 4. The plot always follows and approaches the diagonal line based on the output chart below (Fig. 4). Therefore, it can be concluded that the residual value is normally distributed based on guidelines for decision-making in the probability plot (p-plot) normality test. Thus, in the regression model, normality assumptions for residual values can be fulfilled.

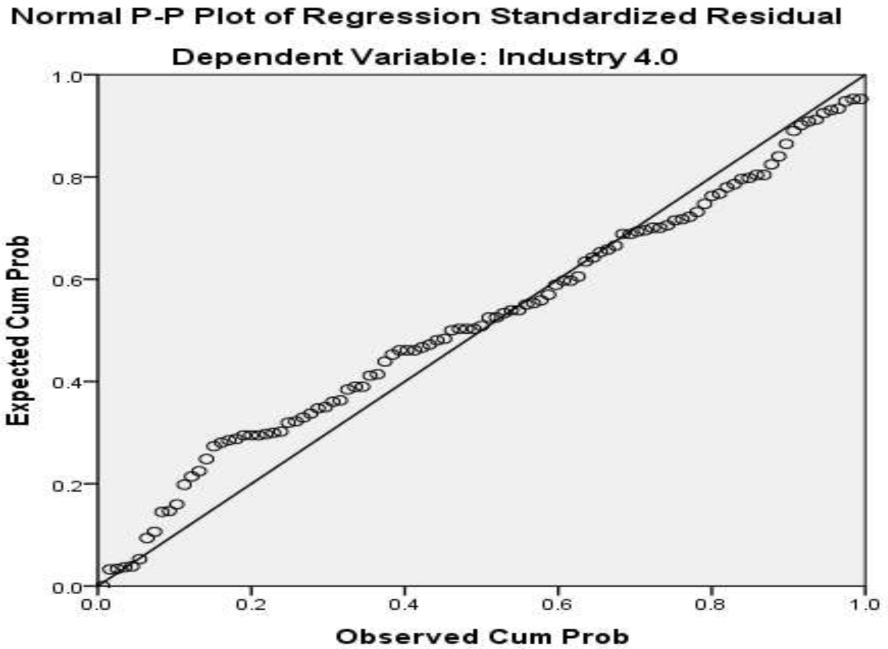

Figure 4 Normality test result (P-P Plot)

4.4.3 Heteroscedasticity Test

The heteroscedasticity test is carried out after multicollinearity and normality tests. The results obtained from the heteroscedasticity test with Spearman rho are in Table 8. The Sig (2-tailed) towards unstandardized residuals on variables X and Y with all the variables value with Sig. (2-tailed) > 0.05. According to the decision-making guideline previously mentioned that If the Sig. (2-tailed) > 0.05, then there is no symptom of heteroscedasticity problem.

Table 8. Heteroscedasticity Test result

Correlations

			Lean Practice	Industry 4.0	Unstandardized Residual
Spearman's rho	Lean Practice (X)	Correlation Coefficient	1.000	.101	.080
		Sig. (2-tailed)	.3333	.308	.422
		N	103	103	103
	Industry 4.0 (Y)	Correlation Coefficient	.101	1.000	.965
		Sig. (2-tailed)	.308	.3333	.171
		N	103	103	103
	Unstandardized Residual	Correlation Coefficient	.080	.965	1.000
		Sig. (2-tailed)	.422	.171	.000**
		N	103	103	103

**. Correlation is significant at the 0.01 level (2-tailed).

4.5 Hypotheses Test

Following the classic assumption test (multicollinearity test, normality test, and heteroscedasticity test), a hypothesis test consisting of t-test, F-test, and determination coefficient (R square) will be performed next.

4.5.1 t-Test

As the first test in a series of hypothesis tests, a t-test is performed with the result of the t-table 1.984. The t-count test is in Table 9.

Table 9. t-Test result Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
	(Constant)	44.412	5.651		7.859	.000
	X_1	1.676	.402	.404	4.503	.000
	X_2	.373	.361	.137	2.033	.034
1	X_3	.089	.450	.027	2.199	.043
	X_4	-.745	.363	-.260	-.257	.075
	X_5	.102	.356	.035	2.052	.043
	X_6	.200	.397	.070	3.003	.026

Dependent Variable: Industry 4.0

The results of the t-test for variable X were derived based on the performance of the t-test conducted in Table 9.

Sub variable X_1 (equipment and method): Sig. 0.000 < 0.05; t-count 4.503 > 1.984 is not rejected on variable Y (industry 4.0)

Sub variable X_2 (manufacturing planning and control): Sig. 0.034 < 0.05; t-count 2.033 > 1.984 is not rejected on variable Y (industry 4.0)

Sub variable X_3 (human resources practices): Sig. 0.043 < 0.05; t-count 2.199 > 1.984 is not rejected on variable Y (industry 4.0)

Sub variable X_4 (product design): Sig. 0.075 > 0.05; t-count -0.257 < 1.984 is rejected on variable Y (industry 4.0)

Sub variable X_5 (supplier relationship): Sig. 0.043 < 0.05; t-count 2.052 > 1.984 is not rejected on variable Y (industry 4.0)

Sub variable X_6 (customer relationship): Sig. 0.026 < 0.05; t-count 3.003 > 1.984 is not rejected on variable Y (industry 4.0)

4.5.2 F-test

The next step after the t-test is to conduct an F-test using Analysis of Variance (ANOVA) with the test results in Table 10.

Table 10. F-test result ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	141.666	1	141.666	3.984	.000**
	Residual	3883.888	101	38.454		
	Total	4025.553	102			

Dependent Variable: Industry 4.0.

Based on the output in the ANOVA (Table 11) above it is known that the F-count is 3.984 and the Sig. value 0.000. Because the value of F-count 3.984 > F-table 3.94 and Sig. 0.000 < 0.05 probability, according to the basis of decision making in the F-test, it can be stated that there is a simultaneous positive influence between lean practices and the industry 4.0 implementation within SMEs in Indonesia. H1 not rejected

4.5.3 Coefficient of Determination (R Square)

The R Square or correlation coefficient of determination results as shown in Table 11.

Table 11. R-Square result Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.816[a]	.665	.631	4.201

Predictors: (Constant), Lean Practice

The determination coefficient or R Square obtained in Table 12 is 0.665 derived from the square of the correlation coefficient or R of 0.816 based on the output results in the model summary table. The determination coefficient is 0.665 or 66.5 percent. This figure means that the variable X (lean production) affects the variable Y (industry 4.0) by 66.5" percent and other variables that are not examined influence the rest.

4.6 Results of Interview

Base on the interview result, SMEs in Indonesia are in progress to conduct lean production and industry 4.0. The results of interviews support the results of questionnaires. The result refers to the fact that there is a truth of the information between questionnaires and interviews derived from twenty-five factories in SMEs Indonesia in Table 12.

Table 12. The Summary of Interview

No	Question	Answer (in majority)	Others
1	Is manufacturing equipment available in good condition and has the correct SOP to support operations?	Equipment and machinery are good. SOP and scheduled and preventive maintenance	-
2	Has integrated production planning been carried out to support on-time delivery (OTD)?	Companies provide a special unit with their main responsibility as Production Planning and Inventory Control (PPIC) to make sure that their production	-
3	How is the waste disposal system implemented and effectively applied?	Implement wastage disposal policy in work instruction and SOP. Internal audit activity is conducted periodically. followed up the findings from the audit report. improvement efforts.	Waste is segregated properly for recycling purposes and to reduce waste to the landfill

4	Is there a training activity evaluation according to the needs of the employee? Is there any review of the effectiveness of the training activities after the training has been performed?	Implementing training activity Review training effectivity (opinion from the training participants compared with the performance)	The company also review the training effectivity based on sales target, production output, customer complain rate, production shipment rate, etc. (avg. every 6 Month)
5	Does each employee have an individual KPI to achieve? What is the application like?	KPI per unit or group	-
6	Is there a strong supplier-company partnership with a long-term focus and is the company undertaking an evaluation of each supplier?	Main supplier companies with a long-term focus and to the company but not taking evaluation by frequent	-
7	Does the company take optimal care to preserve customer loyalty and satisfaction following sales of goods sold to consumers?	Customer care program after-sales	Company conduct customer care program and twice a year by using the questionnaire to their main customer to discover their satisfaction level
8	How is the company's application of IoT? What are infrastructures like?	The IoT application is relatively up to date. The infrastructure design is according to each standard. IoT related knowledge to employees has a strong influence	The IoT application fulfills the needs to be used in continuous operation. In general, the employees have an adequate understanding of IoT
9	How does the company incorporate cloud-computing services and provide facilities to sustain the activities of the company?	The company implements standard Cloud computing services and adequate facilities are provided	Most of the company has their priority of cloud computing
10	What is the scale of the companies priorities in	scale 3-6 of 10 in 15 companies	-

	addressing the cyber threat, particularly in terms of infrastructure preparedness?	scale 7-9 of 10 in 10 companies	-
11	Do the system integration contained in the organization promptly and reliability help decision making	Depend on the level of the adoption.	Some executives still implement the traditional way for decision-making (based on their experiences and business sense).

The main conclusion from the interview session with the informants are concluded as follows: lean practices are already implemented by most Small and Medium Enterprises in Indonesia that participated in this study. Furthermore, for the phenomenon of Industry 4.0 already adopted by the participated companies. Nevertheless, SMEs in Indonesia put their priority on human resources, product sustainability rather than product design. majority of respondents do not have an R&D unit for doing product design, for product design the make out-sourcing to another factory.

4.7 Discussion

Base on research findings, the study examines the link of a variable on the degree of significant value for variable X (lean production) on variable Y (industry 4.0). The study also analyzes the results of interviews to examine the link between lean production factors and industry 4.0 of a factory in Indonesia had been implemented. The study highlight discussion as follow:

A) It is calculated that the significance value (Sig) for sub-variable X_1 (equipment and method) is 0.000 and the t-count is 4.503 based on the output in the table above. Along with Sig. 0.000 < probability 0.05 and t-count is 4.503> t-table 1.984, notably that there is a positive influence sub-variable X_1 (equipment and method) on variable Y (industry 4.0)

B) The significance value (Sig) for sub-variable X_2 (manufacturing planning and control) is 0.034 and the t-count is 2.033. Along with Sig. is 0.034 < probability 0.05 and t-count 2.033 > t-table 1.984, it is revealed that there is a positive influence for sub-variable X_2 (manufacturing planning and control) on variable Y (industry 4.0)

C) For the X_3 (human resources practice), sub-variable, the significance value (Sig) is 0.043 and the t-count is 2.199. It is recognized that Sig. 0.043 < 0.05 and t-count 2.199 > t-table 1.984, primarily that there is a positive influence sub-variable X_3 (human resources practice) on variable Y (industry 4.0)

D) The significance value (Sig) for the sub-variable X_4 (product design) is 0.075 and the value of the t-count is -0.257. Sig. 0.075 > 0.05 and t-count -0.257 < t-table 1.984. There is a negative influence sub-variable X_4 (product design) on variable Y (industry 4.0)

E) The value of significance (Sig) for the X_5 (supplier relationship) sub-variable is 0.043 and the value of the t-count is 2.052. Sig. 0.043 < 0.05 and t-count 2.052 > t-table 1.984, that the sub-variable X_5 (supplier relationship) has a positive influence on variable Y (industry 4.0)

F) The Sig. value for sub-variable X_6 (customer relationship) is 0.026 and the t-count is 3.003. Sig. 0.026 < probability 0.05 and t-count 3.003 > t-table 1.984, it means that there is a positive influence for sub-variable X_6 (Customer relationship) on variable Y (industry 4.0)

From the interview results and, following the triangulation data, several statements were taken and highlighted as follows:

1. Interviews conducted to the SMEs owner, director, and managers of factories in Indonesia with a highlighted descriptions as follows: Equipment and method, Manufacturing planning and control, human resource practice, supplier relation, and customer relation of factories in Indonesia had been implemented, but for product design is only a few factories in Indonesia implemented it because low of necessity, urgency consideration and a majority of respondents do not have R&D unit for doing product design, for product design the make out-sourcing to other factories. The priority for the SMEs in Indonesia are in the successful implementation of human resources management include skills, training and recruitment, service to customers, raw product capability to sustainable production availability, and capability to learn new technology, SMEs put their priority on the human resources, product sustainability rather than emphasizing in product design.
2. Method, manufacturing planning and control, human resources practice, supplier relationship on variable Y which is industry 4.0. Only product design a negative industry 4.0 in SMEs in Indonesia. Indonesian SMEs are in progress to learn and improve their capabilities to cope with industry 4.0. Furthermore, human resources are being prepared to accept and adopt all necessary improvements to be capable of the system integration of Industry 4.0.

The study derives data from 25 companies with a total of 103 questionnaires from SMEs companies located across several Indonesian provinces. From the validity test, the data is valid and consistent with the decision-making that states If the Sig. < 0.05 and Pearson Correlation is positive, then the item claim is relevant to enable reliability testing of the instrument items. Then the reliability test results are consistent with the reliability test's basic decision making, which states that if Cronbach's Alpha value is > 0.70.

The study applied a classic assumption test consisting of multicollinearity, normality, and heteroscedasticity analysis. There is no multicollinearity in the regression model because the value of the independent variable is < 10 and the value of the tolerance matrix > 0.10. The residual value is normally distributed where the plot always follows and approaches the diagonal line based on the output as shown in figure 4 and there is no symptom of heteroscedasticity problem because of the Sig. (2-tailed) > 0.05

After applies the t-test, the study applies F-test using Variance Analysis (ANOVA). The result is the F-count is 3.984 > F-table 3.94 and Sig. 0.000 < 0.05 probability so there is a simultaneous positive influence between lean practices and the industry 4.0 implementation within SMEs in Indonesia and H1 accepted. R square is 0.665 derived from the square of the correlation coefficient or R of 0.816 based on the output results in the model summary table. It means that variable X affects variable Y by 66.5 percent and other variables that are not examined influence the rest. The study applies triangulation data methodology refers to the result of questionnaires has no different from the result of the interview, therefore the result of the data is valid.

The study shows that there is a positive influence sub-variable X_1 (Equipment and method) on variable Y, there is a positive influence for sub-variable X_2 (Manufacturing and control) on variable Y, there is a positive influence sub-variable X_3 (Human resources practices) on variable Y, There is a negative influence sub-variable X_4 on variable Y, the sub-variable X_5 has a positive influence on variable Y and there is a positive influence for sub-variable X_6 on variable Y. Interviews conducted to the SMEs owner, director, and managers of factories in Indonesia with highlighted description as follows: Equipment and method, Manufacturing planning and control, human resource practice, supplier relation, and customer relation of factories in Indonesia had been implemented, but for product design is only a few factories in Indonesia implemented it because low of necessity, urgency consideration and majority of respondents do not have R&D unit for doing product design, for product design the make out-sourcing to other factory.

Indonesian SMEs are in progress to learn and improve their capabilities to cope with industry 4.0. Furthermore, human resources are being prepared to accept and adopt all necessary improvements to be able to integrate industry 4.0.

Conclusıons and Recommendatıon

From the analysis performed, hypothesis 2 (equipment and method), hypothesis 3 (manufacturing planning and control), hypothesis 4 (human resources practices), hypothesis 6 (supplier relationship) and hypothesis 7 (customer relationship) has a positive influence on the industry 4.0 implementation within Indonesia SMEs, only hypothesis 5 (product design) is a negative influence on the implementation of industry 4.0 by SMEs in Indonesia. Brief description as explained below.

5.1 Conclusion

Figure 5 explains the result from the hypothesis test (F-test and t-test).it shows that lean practice indicators show the relationship to four pillars of industry 4.0 in the SMEs in Indonesia with the result all hypotheses are accepted, except hypothesis 5.

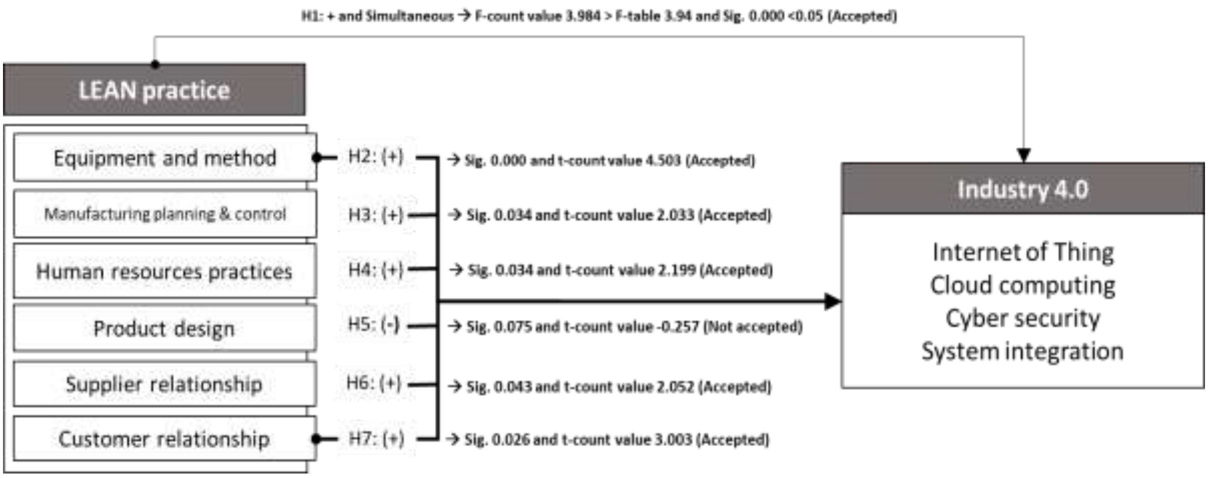

Figure 5 t-test and F-test result summary

5.2 Recommendation

The study has following recommendation for future research and integrates the incorporation of product design in the lean manufacturing practice on the implementation of industry 4.0 within Indonesia SMEs as follow:

1. Further research could be conducted on lean production and 4.0 implementation, which is more comprehensive for all industry companies in Indonesia.
2. Further research could be integrating the incorporation of product design into the implementation of Industry 4.0 within Indonesia's SMEs.
3. Further research could be added to more pillars of Industry 4.0.
4. Further research could be added to the industry Society 5.0

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